

# Multiphasic Testing, 1971

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RECENT YEARS have witnessed an increasing number of multiphasic health testing programs in a variety of settings, including hospitals, group practices, and neighborhood health centers, as well as independent settings physically detached from any other segment of the health services delivery system. As such programs have multiplied, important changes have occurred both in the technologic aspects and in the role which the programs and, indeed, the entire concept of multiphasic testing play with respect to the provision of health services in contemporary society.

An abundance of literature has been addressed to various and specific aspects of this broad subject. Drawing on the wealth of published information, as well as inquiries made of program sponsors, this *Report* attempts to provide a broad overview of the subject.

## *Background*

The concept of health screening is not a new phenomenon to the United States' health care system. Shortly after World War II, screening programs were established by state health departments for the detection of tuberculosis and syphilis. As these programs began to demonstrate their values in detecting disease processes, other tests were added to the original limited-purpose screening effort and multiple screening was envisioned as the next step in a natural progression of events. Although many in the medical community were initially unprepared to accept or did not recognize the need for multiple screening, the

concept continued to be employed in industrial settings and by local public health and voluntary health agency organizations, as well as by some large group practices.

The most widely publicized effort in recent years has been that of the Kaiser-Permanente Health Plan; its program has made Kaiser a model for what has been referred to as "the second generation" of multiphasic testing.\* According to Plan spokesmen, a complete evaluation of that program's effectiveness will not be possible for several years. Nevertheless, the concept of multiphasic testing has increasingly attracted the attention of individuals and organizations who see such a program as a valuable adjunct to services already being made available and one which warrants incorporation into programs of medical care.

A basic type of multiphasic testing includes a self-administered medical history, a series of anthropometric procedures such as height and weight measurements, and a battery of laboratory tests. Such screening usually takes from one to three hours, excluding the follow-up visit with a physician. Initially, the testing process relies heavily on ancillary and clerical personnel, automated equipment and, in many instances, computers, while physician involvement is kept at a minimum.

## *Potential Benefits of Multiphasic Testing*

The value of presymptomatic diagnosis or preventive health care is based on the hypothesis that

\*Recent literature suggests that the term "multiphasic testing" is more appropriate than the term "multiphasic screening," although the two are used interchangeably. In this *Report*, the former has been used for purposes of consistency.

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discovery and treatment at a stage when the disease is still latent or subclinical creates the best possibility of arresting or even reversing the disease process. Essentially, then, multiphasic techniques are designed to identify the healthy appearing, presymptomatic person who in fact possesses signs or symptoms which require further investigation. Conceptually analogous, of course, are the principles of periodic checkups for pregnant women, well-baby care, and prophylactic dental visits. There is also the far broader and more recently stated concept that the role of multiphasic testing transcends merely the early detection of disease, where its value is still questionable, in order to meet the increasing demand for health checkups and health appraisals as the definition of the term "medical care as a right" becomes increasingly broad.<sup>1</sup>

It should be emphasized that, even though multiphasic testing may give early warning of a defect, it is neither intended nor expected by knowledgeable observers to replace a physician's diagnosis. Ideally, test results are utilized by the patient's physician as an aid in conducting a physical examination, making a diagnosis or prescribing treatment.

Multiphasic testing also affords an excellent opportunity for health education. By taking part in the screening process, people may tend to become receptive to learning about various indications of diseases (e.g., obesity, high blood pressure), the nature of common chronic illnesses such as diabetes, the proper care of eyes at middle age, and similar subjects. Other secondary purposes of multiphasic testing may include the accumulation of information for epidemiological research and a further education of the medical profession concerning early manifestations of chronic diseases.<sup>2</sup>

Despite a multiplicity of problems, potential benefits that have been attributed to multiphasic testing by its proponents can be quite significant. Of particular importance are the following:

1. An increase in the quantity and quality of medical records;
2. Accumulation of personal data that can serve as a baseline for comparison with data from future health exams (this is possible only if the agency or physician assumes responsibility for continuity of patients' records);
3. Reduction in the costs of health care to the individual patient and to society by decreasing

hospital inpatient activity and by avoiding expensive complications with early intervention in the disease process;

4. Maximization of physician time which tends to have the effect of reducing the shortage of physicians by utilizing technical aids and ancillary personnel;

5. Expansion of epidemiological knowledge.

In addition to these specific benefits, advocates of multiphasic testing have as an over-all goal a decrease in mortality and morbidity rates among examinees. They are hopeful that they will soon have information to corroborate these proposed benefits. At this time, however, insufficient evidence has been accumulated. (A discussion of problem areas in multiphasic testing may be found later in this *Report*.)

### *Tests Included in Multiphasic Programs*

The tests included in any given multiphasic testing program may vary substantially, depending on such things as cost considerations and the kind of population being tested. The following list of tests is a composite program consisting of tests being done by a minimum of five out of seven major multiphasic testing programs throughout the country. The list consists of 37 tests.

Although many critics of the multiphasic programs maintain that there is no cost-justification for many of the tests being done, the number of tests being included in programs is large and growing rapidly. Among the many possibilities suggested for future inclusion are tests to detect various kinds of cancer, tests to determine the extent and severity of serious mental illness and further testing procedures for the pregnant woman and fetus, including tests for rubella.

Understandably, the development of any multiphasic testing program requires extensive planning and organization. In an effort to determine optimal guidelines to assist organizations in the process of developing a testing program, the National Center for Health Services Research and Development held a national conference on automated multiphasic health testing and services which brought together recognized experts in the field. The proceedings from this conference, which space limitations in this *Report* preclude from being discussed, have recently been published and can serve as an invaluable reference to the interested reader.<sup>3</sup>

### A Composite Multiphasic Testing Program\*

Anthropometry: 1. Height and weight	C. Glucose Tolerance	Ophthalmology: 1. Visual acuity 2. Tonometry
Audiometry	D. Hematology: 1. Hematocrit 2. Hemoglobin 3. Red blood cell count 4. White blood cell count	Questionnaire: 1. Present medical history 2. Past medical history
Cardiovascular Measurements: 1. Blood pressure 2. ECG 3. Pulse	E. Enzymes: 1. LDH 2. Alkaline phosphatase 3. Transaminase (SGOT)	Radiology: 1. Chest x-ray
Clinical Laboratory Procedures: A. Blood Chemistry 1. Bilirubin 2. Calcium 3. Cholesterol 4. Protein, total 5. Protein, albumin 6. Phosphorus, inorganic 7. Urea nitrogen 8. Uric acid  B. Blood Group	F. Syphilis Serology  G. Urine Tests: 1. pH 2. Glucose 3. Protein 4. Blood 5. Ketones 6. Bacteriuria culture	Spirometry: 1. Forced vital capacity (total) 2. Forced expiratory volume (1 second)  Uterine Cervical Cytology (Pap smear, female)

\*The programs from which this list was compiled include: Kaiser-Permanente, Brookdale Hospital Center, Tennessee Regional Medical Program, Tulane University School of Medicine, Milwaukee City Health Department, Rhode Island State Health Department, and IBM Evaluation Program.

### *On-going Multiphasic Testing Programs in California*

Currently there are at least a dozen multiphasic testing programs functioning in California.\* Brief descriptions of these programs are presented below, along with Table 1 which provides information about the programs' medical directors, locations, sponsorships, clientele, and fees. Space limitations preclude full discussion of each program; the descriptions can merely provide some basic information about each program and, when appropriate, indicate any distinctive characteristics.

#### **Automated Multitest Medical Laboratory**

In March 1970, the Palo Alto Clinic opened its multiphasic testing center. The testing facilities were built in cooperation with Automated Medical Laboratories International (AML).

The AML facilities are designed in such a manner that the patient remains in a three-sided cubicle while a central rotating drum brings the testing devices to the patient rather than having the patient move from one station to another. Another distinguishing feature of this system is that one technician is assigned to each patient rather

than having the patient encounter a succession of technicians.<sup>4</sup>

The laboratory has six modular systems allowing a testing capacity of 84 patients per day. The testing costs each patient \$40 and takes approximately two hours of a patient's time. The facility is available only to persons referred by a physician.

#### **Cannery Workers' Health Checkup**

The California Cannery Workers' Health Checkup (also known as Health Testing Services, Inc.) originated as a benefit attained through collective bargaining between the Cannery Workers' Union and the California Food Processors in 1964. The program operates only during the canning season, from June to October. Within this limited time period, the testing facilities are transported to approximately 60 working sites in California and an average of 21,000 cannery workers are tested. The program began operation in 1967; it was continued in 1968 but from then on has operated on a biennial basis.

The testing facilities are contained in a mobile unit consisting of three vans. The facilities are staffed by a combination of professional and non-professional persons who are specifically oriented to interpret the program to the canning community and to be responsive to the screeners' level of health care acceptance, personal fears and misunderstandings, and cultural attitudes.<sup>5</sup>

\*Programs listed represent those about which substantial descriptive information was available to the authors. For a complete listing of on-going programs in California, see the *Multiphasic Screening and Automated Health Evaluation Programs Directory* published by Multiphasic Screening Newsletter. The inclusion of specific programs in this Report does not constitute their endorsement or approval by the California Medical Association.

TABLE 1.—*On-Going Multiphasic Testing Programs in California, as of November 1970*

Program	Medical Director	Location	Sponsorship	To whom available	Fee
Automated Multitest Labs	Hilliard Estes, M.D.	Palo Alto	Private corporation in cooperation with Palo Alto Clinic	M.D. referrals	\$40.00
Cannery Workers Health Checkup	(a)	Mobile Unit	Union and Management Health and Welfare Fund	Union members	(b)
Comprehensive Health Testing Labs, Inc.	Robert Morris, M.D.	San Francisco	Private corporation	Employee groups; M.D. referrals	\$15-65
East Bay Screening Center (Alta Bates)	David Singman, M.D.	Berkeley	Alta Bates Hospital with Medidata Sciences, Inc.	M.D. referrals	\$40.00
East Palo Alto Community Health Center	Eugene Patterson, M.D.	East Palo Alto	Regional Medical Program	Area residents	(b)
Health Evaluation Systems, Inc.	Lawrence Taylor, M.D.	Los Angeles, West Covina, San Diego, Highland Park	Private corporation	M.D. referrals	\$25-50
InterHealth	Charles Ross, M.D.	San Diego	Private corporation	M.D. referrals	\$55.00
Kaiser Foundation	Morris Collen, M.D.	Oakland, San Francisco	Prepaid group practice plan	Plan subscribers; Non-member M.D. referrals	0-\$3.50 \$30-40
Predictive Medicine Program (Retail Clerks 770)	W. C. Martin, M.D.	Los Angeles	Retail Clerks Unions and Food Employers Benefit Fund	Members of union local	(b)
St. Francis Multiphasic Program	Lawrence Carr, M.D.	San Francisco	Hospital	M.D. referrals	\$50.00
St. Mary's Health Appraisal Program	James Diestel, M.D.	San Francisco	Hospital	M.D. referrals	\$50.00
San Joaquin Health Checkup	Virgil Gianelli, M.D.	Stockton	County Medical Society with Regional Medical Program funding	Migrant workers; urban poverty groups	(b)

(a) This program has a consultant board for all projects. The board currently includes: Gerson Biskind, M.D., William Kieferdorf, M.D., Harold Rosenblum, M.D., Samuel Sherman, M.D., and Earl Stern, M.D.

(b) Free to qualified persons.

The follow-up visit has been a major concern in this program. During the first season of testing, one-third of the cannery workers did not have an established family physician. The administrators of the Health Checkup, with the help of county medical societies, were able to alleviate this problem to the extent that only 11 percent of the examinees were unable to name a personal physician when the program was repeated in 1968.

### Comprehensive Health Testing Labs, Inc.

Comprehensive Health Testing Labs, a private corporation, began operating in San Francisco in the latter part of 1969. It provides multiphasic testing to employee groups and to patients referred by a physician.

CHTL offers several basic test programs and provides open-ended selection capabilities so as to suit the multiphasic test panel to specific needs of groups of employer-union clients or physicians. The programs include the Comprehensive Multiphasic Laboratory Examination (\$65), the Physician's Preoperative Multiphasic Panel (\$46), and others scaled down in cost and scope.

This screening center is designed to handle fifty to sixty patients per day, using specially trained paramedical personnel who perform nearly all the tests for each patient in a private, specially equipped examining room. Although there is presently only one testing site, plans exist for modular multiphasic health screening centers. These modular laboratories could keep their costs at a minimum by utilizing the automated equipment and central computer bank of the parent laboratory.

### East Bay Health Screening Center

The East Bay Health Screening Center is a part of the Alta Bates Community Hospital in Berkeley. The program first began accepting physician-referred patients in January 1970 and was one of the first screening programs to operate in a private community hospital for utilization by private physicians. The facility was designed by Medidata Sciences, a division of G. D. Searle and Company, which seeks to place such complete testing units in other hospitals throughout the country.

A significant feature of this program is that the medical history is taken by means of a computer console which can pose as many as 320 questions on a video screen. The patient's response is relayed to the computer through a push-button control. Since each series of questions is dependent

upon the patient's response to previous questions, only necessary questions are asked.

The screening process includes approximately 40 tests and the medical history. The cost to each patient is \$40. The center has a capacity of up to 80 patients per day. Although the center has not been in operation long enough for its utilization by community physicians to be effectively determined, a recent study shows that approximately 75 percent of the Alta Bates staff plan to use the services in their medical practices.<sup>6</sup>

### East Palo Alto-East Menlo Park Neighborhood Health Center

At the time this *Report* was prepared, the East Palo Alto Neighborhood Health Center indicated its plans to begin a multiphasic testing program in December 1970. The testing program will be underwritten entirely by federal funding provided through the California Committee on Regional Medical Programs for a one-year period.

The testing program will be a routine procedure in the Health Center's process of care. Test results will automatically be sent to the patient's physician at the Center; hence, a follow-up visit is assured. Plans for the testing program estimate that approximately 275 patients will be tested each month.

### Health Evaluation Systems, Inc.

Health Evaluation Systems opened their first screening center in West Covina in 1968. Since then, additional centers have been established in San Diego in 1969 and in Los Angeles and Highland Park in 1970. The centers are privately owned and are designed to test individual patients and employee or union groups.

In order to meet the fluctuating needs of both patients, the HES centers offer flexibility in the sequence of tests performed on any given patient or group. The cost of the testing for individual patients ranges from \$25 to \$50; each center has a capacity of 50 patients per day.

In the near future, HES plans to begin operating a master information system which will receive and process patient data supplied from HES centers throughout the nation. This information will allow patients' medical records to be tabulated and compared to the HES national file. This system will also allow a patient's medical record to follow him if he moves from one region to another.

## InterHealth Med-test Centers

InterHealth, a private corporation, is jointly owned by a large group of physicians and by Systems, Science and Software, a computer science and technology firm. The parent laboratory was opened in San Diego at Grossmont Medical Center in November 1970.

InterHealth plans to establish eight to ten satellite testing centers which will open at two- to three-month intervals according to patient demand. The central clinical laboratory and computer installation will process patient data from the respective testing centers.

Each testing center will have the capacity to test 30 to 40 physician-referred patients per day. A standard battery of tests costs a patient \$55 and requires approximately one hour of a patient's time. Should the physician wish to order specific additional tests, however, these too can be arranged for an additional charge.

## Kaiser Foundation Health Plan

Undoubtedly the best known and most emulated multiphasic testing program is that which has been operating through Kaiser Hospitals in Oakland and San Francisco since 1950. It was, however, not until 1964 that the program was revised to implement automated testing procedures. The testing is available both to Kaiser members and non-members; all patients, however, must have an appointment with a physician for a follow-up visit before they may participate in the multiphasic testing program.

Both testing centers have an average patient load of 2000 per month, based on a 40-hour week. Forty percent of those persons tested are over age 50; minors may participate in the program with written consent from their parents. According to their plan coverage the charge for multiphasic testing varies among members from no-charge to a maximum of \$3.50. The charge is \$30 for non-members with the exception of women aged 48 and over if they are to receive a mammography.

The Kaiser program is administered by having the examinee proceed to 20 different stations in a period of two to three hours. By the time the examinee has finished at Station 20, the "on line" computer processing of selected test results has been completed and necessary additional tests and appointments are arranged for the examinee. Simultaneously, the "off line" computer collates

and stores the remaining information (physician interpretation from the EKG, roentgenograms, and the retinal photograph; the remaining laboratory test reports; and the key-punched medical questionnaire form). When all of the final information has been received and stored, the computer produces a printed summary of test results and questionnaire responses.

Because their testing centers have been operating longer than most and because of their larger-than-average patient load, the Kaiser program is one of the few that have been able to publish meaningful data such as the incidence of and costs per positive finding. Some of these data are contained later in this *Report*. In the future it will be data such as these that will be necessary for assessing the actual worth of screening for the patient and the physician.

## Predictive Medicine Program

(Retail Clerks Unions and Food Employers Benefit Fund)

The Predictive Medicine Program was established in Los Angeles by the Retail Clerks Local 770 and the Food Employers Benefit Fund for the purpose of giving union members and their dependents routine access to a medical examination which would include both physical and laboratory tests. This benefit, which is totally without charge, is in addition to the regular health plan which provides for a dual option of either the Kaiser Plan or an indemnity plan.

The program has been operating for nearly five years. Throughout this time, health education has been one of its major objectives. A nutritionist is stationed at one of the testing areas to discuss diet, exercise, smoking habits, and general hygiene with the patient.<sup>7</sup>

Special emphasis is also placed on the follow-up visit. Hence, a physician is employed by Predictive Medicine to insure a follow-up for those persons who do not either belong to the Kaiser Plan or have a personal physician.

## Saint Francis Multiphasic Physical Examination

St. Francis Hospital in San Francisco began operation of its multiphasic program in 1969. The program is on a smaller scale than most multiphasic testing programs in the State. It was designed entirely by members of the hospital staff

and is made available to patients of physicians on the staff. Using existing in-house facilities and equipment, the testing capacity is approximately five patients per day; at present, an average of five patients are tested each week. The charge for the testing procedure is \$50. To assure a follow-up visit, every patient must be referred by a physician.

### Saint Mary's Health Appraisal Program

In 1968 St. Mary's Hospital and Medical Center began its health appraisal program. This Multisystems testing program is available to patients of any physician and is restricted only insofar as all patients must have been referred by a physician. In addition to such referrals, one contract with a union health and welfare plan for testing its members is currently in existence.

The program was developed entirely by the hospital staff and utilizes existing facilities and equipment. The charge for the testing is \$50 per patient. At present, approximately five to six patients are tested each day; the program has the capacity to test 50 patients per day.

### San Joaquin Health Checkup

The San Joaquin Health Checkup was conceived by the San Joaquin County Medical Society and its foundation for Medical Care and is being funded federally through the California Committee on Regional Medical Programs. Funding originally became available in mid-1970, at which time the program began, and is guaranteed for a three-year period.

The health checkup is designed to bring preventive and continuing medical care to economically disadvantaged urban families and migrant workers in the area. The goal of the program is to test 3,000 persons annually for the next three years and, in this way, bring into the health care system those who might otherwise remain outside it.

Whenever possible, the program utilizes personnel and equipment used in the Cannery Workers' Health Checkup; thus, the testing facilities are housed in mobile vans. Tests for lung function, blood pressure, visual acuity, heart function, various x-rays, and blood and urine tests (and "Pap" tests for women) are carried out by a staff of bilingual physicians, registered nurses and technicians. The testing is free for qualified persons; the estimated cost per examinee is \$34.<sup>8</sup>

The San Joaquin Foundation for Medical Care plays a vital role in organizing the provision of necessary follow-up services for those persons not having an established relationship with a physician. Migrant camp residents are referred to existing camp clinics; urban residents are referred to the Pearl Sifford Clinic. Persons requiring services not provided by a clinic are referred to the County General Hospital on a special outpatient basis established within the framework of the outpatient department.

Although many of the programs described above have not yet published data on the cost of initiating and maintaining their multiphasic programs, a few testing centers have been operating long enough and on a large enough scale to provide such information. It is important to note the high initial cost of a testing program, since this should be a significant factor in evaluating the need for establishing more testing centers before those existing centers are utilized to capacity. The only factor that can offset the major expense of a screening program is capacity utilization.

A comparison of expenditures for establishing and operating screening programs is difficult because of (a) varying numbers of examinees, (b) varying numbers of tests performed and (c) different accounting techniques. There are other intrinsic differences peculiar to individual programs which make comparisons difficult. For example, although the East Bay Screening Center and the Kaiser program are both hospital-based, the latter operates on a much larger scale and has operated for a longer period of time. Furthermore, Kaiser is essentially a closed system and has been able to incorporate multiphasic testing into its over-all health care program, while the East Bay Screening Center is dependent upon outside physician referral and is itself "free standing." The Cannery Workers' program varies in other respects, being a mobile unit that operates discontinuously. Thus, the cost information presented below is somewhat limited in terms of providing a basis for meaningful comparisons.

Nevertheless, the data are in themselves of general informational value for persons considering the establishment of such a program or evaluating various existing programs. Again, space limitations in this *Report* preclude extensive discussion of costs of individual programs; for detailed information, the reader is directed to the source material cited.

**TABLE 2.—Operating Expenditures and Cost Per Examinee for the Cannery Workers' Health Checkup, 1968**

Component	Total	Cost Per Examinee
Trailer moving .....	\$ 16,000	\$ 0.76
Field operation .....	214,100	10.19
Field personnel .....	177,200	8.44
Testing supplies .....	28,100	1.34
Other field expenses .....	8,800	.41
Professional contracts .....	212,000	10.10
Data processing .....	78,000	3.71
Central office .....	244,200	11.67
Personnel .....	162,900	7.82
Rent .....	19,400	.92
Accounting and legal .....	10,200	.48
Supplies and equipment .....	35,600	1.69
Other .....	16,100	.76
Travel .....	11,000	.52
TOTAL .....	\$775,300	\$36.95

### The East Bay Screening Center

A complete breakdown of expenditures by the Alta Bates Community Hospital on the establishment of the East Bay Screening Center is not available at present; however, some of their major expenditures include the following. Based on a patient load of 50 patients per day, the annual operating budget is estimated at \$437,000. Two major expenditures include \$100,000 for a furnished building in which to house the program and the cost of leasing the computer and testing equipment which is valued at \$350,000.<sup>6</sup>

### Cannery Workers' Health Checkup

The Cannery Workers' Health Checkup has published a summary of operating costs for 1968. These figures, along with the cost per examinee, are outlined in Table 2.

The total operating costs for 1968 amounted to \$775,300. Of this total annual cost, 31.6 percent (\$244,200) was spent on maintaining the central office. Other major expenses included the cost of field operations (\$214,100) and of professional contracts (\$212,000) which amounted to 27.6 and 27.3 percent, respectively, of the total annual cost.

Calculated from a total patient load of 20,990, the cost per examinee was \$36.95. However, it was estimated that the cost per examinee would be reduced to \$26.96 if the patient load were increased to 50,000 examinees who could be tested if the program were expanded to operate on a year-round basis.

Capitalization costs necessary to initiate the program totaled \$203,900. This included the cost

**TABLE 3.—Total and Per Unit Cost of the Kaiser-Permanente Multiphasic Testing Program, September 1967-August 1968**

Component	Total	Cost Per Examinee*
Direct costs .....	\$585,249	\$12.34
Equipment depreciation ...	54,557	1.15
Salaries and wages .....	407,835	8.60
Supplies and equipment .....	122,857	2.59
Allocable indirect costs .....	91,964	1.94
Unallocable indirect costs .....	333,724	7.04
Computer center and data processing .....	213,318	4.50
Central staff .....	120,406	2.54
TOTAL .....	\$1,010,653	\$21.32

\*Based on a patient load of 47,404.

of equipment (\$186,400) as well as the cost of planning (\$17,500).<sup>5</sup>

### Kaiser-Permanente Multiphasic Testing

The Kaiser multiphasic program has reported operating costs for one year, from September 1967 to August 1968. Direct and indirect operating costs and the cost per examinee are outlined in Table 3. It is important to note that these figures were based on the operation of the screening centers in San Francisco and in Oakland.\*

The cost per examinee was calculated to be \$21.32 on the basis of 47,404 patients tested during that period. Direct costs, which included equipment depreciation, salaries and wages, and supplies and equipment, totaled \$585,249. These direct costs accounted for 57.9 percent of the total annual cost of \$1,010,653.

Indirect costs were separated into those expenses which could be allocated to specific aspects of the program and those which could not. Allocable indirect costs amounted to \$91,964, or 9.1 percent of the total annual cost, while unallocable indirect costs amounted to an additional \$333,724, or 33.0 percent of the total. The latter included the cost of the data processing (\$213,318) and of the central staff (\$120,406) which provided the administrative, instrumentation, systems, statistical and epidemiological personnel utilized in the program.<sup>9</sup>

### Dollar Cost Per Positive Test Finding

An additional and important type of information is that relating to the cost per positive find-

\*Similar cost information has been published for the Tulane Health Maintenance Project. (MacKintosh D, Krause G: Cost analysis of the developmental phase of an automated multiphasic health testing facility. Public Health Reports 85:685-689, August 1970.)

**TABLE 4.—Cost Per Positive Test in Kaiser-Permanente Program, 1967-68**

Test	All ages			Age 60 and over	
	Unit cost	Percent positive	Cost per positive finding	Percent positive	Cost per positive finding
Mammography	\$4.90	1.2%*	\$408.00*	1.4%	\$350.00
Electrocardiography	1.02	17.3	5.90	31.5	3.20
Tonometry	.55	0.3	183.00	0.5	110.00
Chest x-ray film	.46	7.4	6.20	19.2	2.40
Blood pressure	.42	4.1	10.20	11.5	3.65
Respirometry	.31	2.2	14.10	2.7	11.50
Visual acuity	.29	15.8	1.85	26.3	1.10
Audiometry	.25	16.2	1.55	36.4	.70
Ankle reflex	.24	1.5	16.00	1.6	15.00
Hemoglobin (men)	.42	3.1	13.55	5.6	7.50
Hemoglobin (women)	.42	10.3	4.10	5.5	7.60
White cell count	.42	2.2	19.10	1.7	24.70
Serum glucose (1 hour)	.75	5.7	13.15	8.3	9.05
Serum cholesterol	.29	2.4	12.15	3.0	9.70
Serum uric acid	.29	4.5	6.40	6.0	4.80
Serum albumin	.29	0.3	96.70	0.4	72.50
Serum total protein	.29	4.0	7.25	3.9	7.45
Serum calcium	.29	1.3	22.30	1.5	19.30
Serum creatinine	.29	1.4	20.70	2.7	10.70
Serum transaminase	.29	4.2	6.90	4.5	6.45
VDRL	.16	1.5	10.65	2.3	6.45
Urine culture (men)	.20	0.4	50.00	1.0	20.00
Urine culture (women)	.20	3.3	6.05	4.0	5.00
Urine glucose	.18	8.2	2.20	7.3	2.50
Urine protein	.18	6.4	2.80	7.0	2.60

\*Women 50 years of age or older.

ing in testing programs. As yet, Kaiser-Permanente is the only California program to have compiled extensive data of this nature. Their information describes the cost per positive test, based on 44,663 multiphasic examinations performed between September 1, 1967 and August 31, 1968. As can be seen in Table 4, the cost per positive case ranged from \$1.55 per positive audiogram to \$408.00 per positive mammogram. Obviously, this type of unit cost is contingent on the characteristics of the population tested. Nevertheless, the data provide an important tool for evaluating the cost-effectiveness of multiphasic testing.

The unit cost for mammography, including interpretation of x-rays by a radiologist, was \$4.90. Mammograms were provided only to women over age 50. The incidence of positive cases was 1.2 percent and cost per positive case, \$408.00. For women 60 years of age or older, the positive incidence increased to 1.4 percent, thus decreasing the cost per positive case to \$350.00. In his recent article, Garfield notes that, if 500 women were tested, these findings could alternatively be

stated in the following manner: "It cost \$4.00 each to assure 499 women there is no evidence of breast cancer by mammography and \$4.00 to detect one cancer that through early surgery may have a better prognosis."<sup>1</sup>

Tonometry, with a low over-all unit cost, also had a relatively high cost of \$183 per positive case, since the positive incidence was a very low 0.3 percent for all persons tested. Among the age group 60 and over, however, the 0.5 percent with positive findings lowered the cost to \$110 per positive case.

It is interesting to note that the unit cost for an electrocardiogram was one of the highest (\$1.02); however, the high incidence of positive findings (17.3 percent) resulted in a relatively low cost per positive case (\$5.90). If only those persons 60 years of age or older had been tested, the cost per positive case would have been reduced to \$3.20. The age relationship is even more dramatic in blood pressure testing, in which the cost per positive finding of persons under 40 was \$105.00, while the cost for persons 60 and over was \$3.65.<sup>10</sup>

## *Problems and Controversies*

### *About Multiphasic Testing*

Many physicians are apprehensive about accepting multiphasic testing as an integral part of their routine practices. Their apprehension is based not only on the belief that multiphasic testing represents an impersonal, assembly-line type of medical care, but also on some of the problems of testing such as the incidence of false positives and false negatives. It is understandable, furthermore, that the physician will not readily accept multiphasic testing programs if the results do not justify the costs or if they provide the patient with a false sense of security regarding his health status.

Some physicians who have worked with testing programs cite false positives as their main criticism. They would prefer spending their time with a person clearly in need of specific diagnostic or therapeutic procedures, rather than assuaging the fears of a patient whose testing falsely indicates a positive result. Although a certain percentage of false positives is unavoidable, a physician burdened with invalid test results is bound to question the worth of testing.

Kaiser-Permanente handles the problem of false positives by considering the nature of the disease being tested for in each testing procedure. With a disease such as tuberculosis, they set the level so that anyone with a questionable x-ray is called back. They are willing to risk false positives on conditions that are potentially important to the patient. However, with less serious conditions, they raise the testing levels, knowing that some mild cases will be overlooked until the following year.<sup>11</sup>

Test results which are false negatives create an equally important problem. If a patient does not understand that testing results alone are not a complete and sufficient diagnostic survey, false negatives may give him an inaccurate sense of security about his health. It is also important that examinees do not consider the test results to have predictive value concerning possible health problems in the future.

An important objective of most testing programs is to improve the definition of normal values. Efforts are being made to include more parameters in defining what is normal and what is not, and to individualize evaluations by including and adjusting for such factors as biological rhythms (year, month, day) and drugs being

taken. There remains a considerable amount of concern in the medical community with respect to the establishment of normal ranges.

Another area in question is the effect that testing will have in relation to the medical manpower and facilities shortage. Many proponents of testing argue that one of its benefits will be to alleviate the physician shortage by making more effective use of ancillary personnel. As yet, there is no evidence either to refute or to affirm this hypothesis. Furthermore, since another proposed benefit of testing is that it will be able to reach larger portions of the population, it is possible to anticipate that the immediate effect of any increase in the amount of testing done will be to increase the strain on all types of manpower and facilities, most of which are already in short supply. The very existence of programs, especially those available at no charge, cannot but increase the number of the "worried well" who utilize facilities and personnel. Although this problem may prove to be short-range in nature, it is an understandable concern to those who are called upon to provide these additional services.

The effect of multiphasic testing on the utilization of health care facilities and personnel will probably be a function of what segment of the population being so tested has already been undergoing some sort of routine screening or annual health examinations. Additionally, one must also take into account not only the manpower and facilities used in the testing programs, but also the resources utilized in the follow-up visits or the possible hospitalization necessary to treat the conditions detected in a testing program. Optimally, this whole dilemma will be resolved with allocation of scarce and expensive resources to the area where the least input produces the greatest results, within the limitation of providing adequate resource allocation to areas of immediate or critical need.

The success of a multiphasic program is dependent on the referral to and follow-up by physicians both within and outside of the testing program. Persons organizing multiphasic programs are aware of the importance of the follow-up visit and will usually make intensive efforts to effect patient-physician follow-up contact.

Nevertheless, there are follow-up problems which are difficult to control under an open system, such as the following:

1. the examinee does not go to a physician as he was directed;
2. the patient does not follow the course of treatment outlined by the physician; or
3. the examinee has no family or personal physician.

Unfortunately, while testing holds the greatest potential for helping to alleviate health problems among the urban poverty population, it is this group with its high illness rates and physician shortages that seems to be most vulnerable to failure in the follow-up process.<sup>2</sup> Even among other groups, health care coverage which does not provide reimbursement for follow-up services can constitute an effective barrier to this important aspect of testing programs.

The concern with the follow-up visit is relatively less critical in closed systems such as Kaiser than in other settings. In general, however, testing programs currently being developed are designed to insure a follow-up by requiring physician referral to a participant in the testing program or, as in the case of San Joaquin Health Checkup, the program assures physician-patient contact through arrangements with county medical societies, local health clinics, or county hospitals. Also, those programs based solely on physician referrals have a built-in follow-up mechanism.

There is one final area of concern on the part of many physicians. It has been observed that in many instances early detection of abnormalities serves little useful purpose in the provision of medical care, since no immediate measures for dealing with many of these abnormalities, either therapeutically or with measures to prevent their further development, are agreed upon in the medical community. The value of testing for such abnormalities is indeed open to question when subjected to a cost-benefit analysis.

### *The Future of Multiphasic Testing*

While the success or failure of multiphasic testing is dependent on many variables, it can indeed serve as an effective and economical means of providing health screening examinations for large numbers of people. Multiphasic programs appear to hold considerable potential for populations with little or no current access to the medical care system. The potential is probably more limited with respect to the health care of well-educated, high socio-economic

groups for whom quality care is already available and who possess the sophistication to utilize it.

At least five factors will undoubtedly have a marked effect on the further expansion of multiphasic testing programs in the U.S. health care system. They are the following:

1. A general belief by the medical profession that testing can serve as an adjunct to their practices without endangering their patient relationships or their professional prerogatives. Disappointing numbers of patient referrals to multiphasic testing programs suggest that private physicians actually use available programs to a far more limited extent than many program directors had planned for, based on inquiries within the profession.

2. Based on needs within an area, a rational growth pattern with respect to the development of new programs so as to prevent unnecessary duplication and thus assure optimum utilization and minimum costs to patients being served.

3. The establishment of meaningful criteria for the evaluation of abnormalities in test findings in order for results to be of maximum benefit as diagnostic aids while the numbers of false positives and false negatives are minimized.

4. Further evaluation of testing program content, with emphasis on limiting tests to those which can be cost justified and to further design of programs meeting specific needs of various subgroups within the population.

5. The extent of coverage for multiphasic testing and effective follow-up care in programs of health insurance.

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